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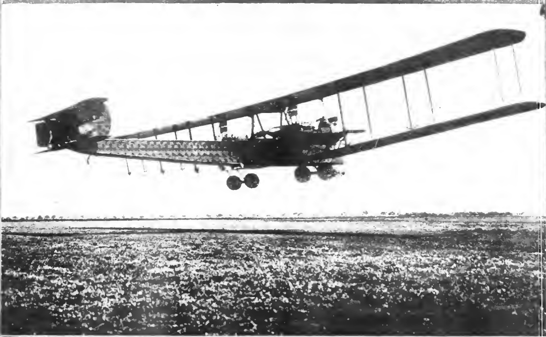

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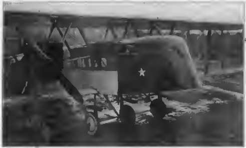

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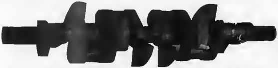

OCTOBER 15, 1919

AVIATION AND AERONAUTICAL ENGINEERING

VOL. VII, NO. 6

Member of the Audit Bureau of Circulations

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AVIATION AND AERONAUTICAL ENGINEERING

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Vol. VII October 15, 1919 No. 6

THE rapidly changing attitude of Congress toward the aviation program is becoming more and more evident as the session nears its close. The Senate seems to be wholly convinced that a separate department is necessary to properly administer any funds appropriated for aeronautics and the Senate is willing to allow sufficient amounts for the purpose of keeping the United States prepared for aerial warfare. The House of Representatives is slowly coming around to the view of the Senate. The matter has unfortunately taken a political turn so that the issues are somewhat confused. Representatives have their eyes on the next presidential campaign and blind economy is the policy in certain directions.

Meantime the engineering development of airplanes and accessories is going ahead slowly, with as much encouragement as can be given by the limited funds available. The aeronautical engineers, while pessimistic over their plight at the moment, are working on designs which can be produced as soon as orders are forthcoming. They have been through lean periods before and are confident that ultimately this country will lead the world in aeronautic design, construction and equipment.

Passenger and Exhibition Flying

One of the most interesting phases of present aviation activities is the great number of small companies engaged in exhibition flights and in passenger flights of short duration. Such work has not yet reached the dignity of aerial transportation work, but nevertheless both activities have considerable educational value for the general public.

In a large majority of cases these small companies carry out their work very creditably, and it is only as a warning note that we suggest that even greater care be exercised by aviators engaged in this work.

There is always the temptation on a small flying field with a couple of machines, where paying passengers are to be found in large numbers, to overrun both the machine and the motor under stress of business. Accidents are likely to happen under these conditions and they are not legitimate accidents. Nevertheless they will be attributed to inherent defects of the airplane and not to an inordinate desire for minutes in the air.

Also, on such passenger and exhibition flights, stunting should be avoided. Even if the passenger does ask for stunt flying, he will not enjoy it. He will come down congratulating himself on being a brave man, but with the feeling that he has had a very serious experience. The passenger should come down, feeling that he has had a perfectly safe and normal experience which he would like to repeat.

If these principles are borne in mind by the various aviators engaged in this work all over the country, it would not be far wrong to say that their work would constitute one of the most valuable methods of popularizing the airplane.

Gasoline Pumps

In the early days of aeronautics, when engines were low-powered and flights of short duration, the gasoline system was a matter of simplicity. But in the commercial plane, equipped with multiple engines, required to run several hours without replenishment, and perhaps flying across country with but few landing places between, becomes more complex and must be completely reliable.

One of the most important component parts of the gasoline system, is the pump itself.

Pumps of the simple plunger system, vane pumps, gear pumps, siphon pumps, generally driven by a flexible shaft from the engine, have been tried. Pressure pumps have been almost totally discarded. But all mechanically driven systems have given rise to difficulties. Pumps which are geared right on to an engine, are not always located in the best possible way for the rest of the system. Flexible shafts are one continuous source of worry.

European opinion, and it would find many supporters in this country, seems to be that a pump with simple vanes, driven by an air turbine, is the best solution.

The air-screw and pump impeller are mounted on the same shaft, nicely streamlined, placed in the slip stream of the propeller, and well below the level of the tank.

The overall efficiency is probably low, but there is complete latitude of position, perfect reliability and simplicity owing to the slip stream of the propeller, the pump works perfectly well before the plane is started.

Several successful air driven pumps have already been tried, and it would seem as if American designers should give such pumps careful consideration in laying out gasoline systems.

Resistance of Navy No. 1 Struts

By A. F. Zahm, Ph.D.
Bureau of Construction and Repair, U. S. N.

Preface.—The tests herein described were made to determine the resistance of four Navy No. 1 airplane struts, and their resistance coefficients in terms of the air speed and thickness. The measurements were made in the 8 in. x 8 in. tunnel at speeds of 20 to 70 m. p. h. The test was conducted by R. H. Smith, the computations and drawings were made by M. T. Birch, both assistants in the aerodynamical laboratory.

Description of Struts.—The struts were of uniform size from end to end, were all 5 ft. long, had a fineness ratio of 3 : 1, and had the shape of section specified in Fig. 1. They were all of pine, shaped to metal templates and varnished. Their nominal thicknesses were respectively 1 in., 2 in., 3 in., 4 in. The dimensions of all the struts, except the largest conformed to specifications, the latter being about 1 per cent too thick. This excess was ignored in tabulating and plotting the resistance values.

Method of Test.—Each strut in turn was held upright on two prongs pointing upstream from the shielded spindle of the Eiffel balance. The center of the model was at the axis of the tunnel, and its chief plane of symmetry was parallel to the side walls. The resistance was measured as usual, first with the strut and holder, then with the strut detached but not removed. The resistance of the holder alone was about 1 per cent of that of the small strut.

Method of Computing Resistance Due to Pressure-drop.—As may easily be shown, the pressure-drop resistance of a strut of uniform section can be expressed by the formula:

$$R_p = 2\, l \int p\; dy$$

in which l is the length of the strut, p the static pressure along the axis of the unobstructed tunnel, and y the half thickness of the strut at successive offsets, the integration extending from front to rear of the model. For the pressure on any element of the strut surface is $p\, l\, ds$, which resolved along stream is $p\, l\, ds\; dy/ds = p\, l\, dy$, the integral of which is as above. The same result obviously follows if p is the pressure-drop in the unimpeded stream along the center line of the strut. This pressure drop and its graphic integration over the four strut surfaces are presented in Figs. 3 and 4 for a speed of 40 m. p. h. For higher speeds the pressure-drop is assumed to increase as the square of the speed. This assumption may, as indicated by some tests still in progress, entail an error of a fraction of 1 per cent of the total strut resistance.

The Resistance Coefficient.—The resistance of a uniform strut held transverse to a uniform current parallel to its plane of symmetry may be written

$$R = \frac{\rho}{g}\, lDV^2 f\left(\frac{DV}{\nu}\right)$$

in which $\frac{\rho}{g}$ is the fluid density, l the length, D the thickness, V the speed, ν the kinematic viscosity. Though for constant fluid conditions f may tend to become constant for the higher values of DV found in airplane practice, it usually varies considerably for the lower values. For convenience in obtaining and using a working formula, the above equation is written

$$R = KDV^2$$

in which R is the strut resistance per foot length in pounds,

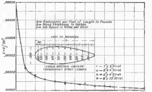

Fig. 1

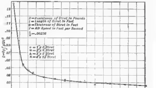

Fig. 2

D the thickness in inches, V the speed in miles an hour, and $K = \frac{\rho}{g} f\left(\frac{DV}{\nu}\right)$. Since the wind-tunnel data are for standard air conditions, K is a function of DV, for similar struts, and R is pounds resistance per foot run for air of standard density, here taken as .07635 lb. per cu. ft.

When K, so derived, is used in computing the resistance of struts for a similar air movement, some correction must be made for end effects, unless the model be geometrically rather than just sectionally similar to said struts. In the present account the end correction is omitted for lack of sufficient data. It may, however, by inference from well-known experiments, be regarded as small.

The resistance coefficient may also be written in the dimensionless form

$$C = Rg/\rho lDV^2$$

in which R is the observed resistance, lD is the projected area, and $\frac{\rho}{g}\, lDV^2$ is the Newtonian resistance of this area. Thus C is a shape coefficient, independent of the units employed, and is called the "absolute coefficient."

Results.—The accompanying table gives the gross and the net resistance of the four struts at various speeds, also the coefficient of resistance K for the conditions therein specified. Fig. 1 shows the relation of K to DV for the tabulated conditions. The data all lie close to a continuous curve which, for increasing values of DV first falls rapidly, then tends to become horizontal for the higher values of DV. Thus, for the range here recorded, K approaches but does not attain constancy, that is, the resistance tends to, but does not actually, vary as the square of the speed.

For convenience in comparing these results with the like

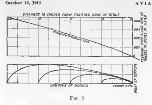

Fig. 3

reported from other laboratories, the shape coefficient C is given in Fig. 2 in ft.-lb. sec. units.

The degree of precision of the measurements may be inferred partly from the consistency of the plotted data, partly from the fact that the average speed of the air past the strut can be determined truly to about one per cent, and that the finest drag indication of the Eiffel balance is about .002 lb. The precision is sufficient to indicate the merits of this strut as compared with others tested in the same way. The error in finding the pressure-drop resistance is probably negligible, since this force is relatively small. Its ratio to the net resistance, at 40 m. p. h., has the following percentage values, respectively, for the four struts taken in their order of thickness: 1.06, 2.82, 4.54, 5.70.

Comparison With Other Struts.—In report No. 131 it will be shown from resistance data, obtained in the way here recorded, for an NPL strut 5 ft. long and of uniform section 3 by 9 in., that this shape has, for ordinary sizes and working speeds, 15 to 20 per cent more resistance than the Navy No. 1 strut of the same over all dimensions. Reference may be made also to Reports and Memoranda (New Series) No. 416 of the British Advisory Committee for Aeronautics, which summarizes the resistance coefficients for all the struts tested at the National Physical Laboratory prior to 1918, and those tested by Eiffel before the outbreak of war in 1914. It delineates K in terms of DV for a strut of minimum resistance, in a plot that would cross above the one shown in Fig. 2 at the distance $DV = 7$, and continue well above it for all the higher values.

Remark.—From this investigation it appears that, for the higher values of DV found in present practice, the Navy Strut No. 1 has a smaller coefficient of resistance than any hitherto reported. No account is now taken of the weight and section modulus of the strut, which usually enter the coefficient of merit. The general effect of these is well known and need not be treated here.

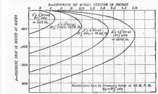

Fig. 4

Numerical data on the resistance tests of Navy No. 1 struts are given in the appended tables.

Resistance of Struts of Similar Section

Air speed in m.p.h.	Measured resistance	Resistance due to pressure-drop	Net total resistance	Resistance R per foot	DV	$K = \frac{R}{DV^2}$
			1"x3" Strut			
20	0.1169	0.0004	0.1165	0.0233	20	0.0000582
30	0.1668	0.0012	0.1656	0.0331	30	0.0000368
40	0.1907	0.0020	0.1887	0.0377	40	0.0000235
50	0.2518	0.0032	0.2486	0.0497	50	0.0000198
60	0.3220	0.0044	0.3176	0.0635	60	0.0000176
			2"x6" Strut			
20	0.0926	0.0018	0.0908	0.0182	40	0.0000228
30	0.1695	0.0040	0.1655	0.0331	60	0.0000184
40	0.2630	0.0074	0.2556	0.0511	80	0.0000160
50	0.3818	0.0112	0.3706	0.0741	100	0.0000148
60	0.5230	0.0166	0.5064	0.1013	120	0.0000141
			3"x9" Strut			
40	0.3465	0.0158	0.3307	0.0661	120	0.0000138
50	0.5160	0.0238	0.4922	0.0984	150	0.0000131
60	0.6815	0.0356	0.6459	0.1292	180	0.0000120
70	0.9360	0.0484	0.8853	0.1771	210	0.0000121
			4"x12" Strut			
40	0.4755	0.0268	0.4487	0.0897	160	0.0000140
50	0.6735	0.0404	0.6331	0.1266	200	0.0000127
60	0.9020	0.0602	0.8418	0.1684	240	0.0000117
70	1.1500	0.0820	1.0680	0.2136	280	0.0000109

R = Resistance per foot of length in pounds.
D = Strut thickness in inches.
V = Air speed in miles per hour.
$\frac{\rho}{g}$ = .00510

Air Service Manuals

Much has already been done in the collection of data and compiling of general valuable information. The Training Division has compiled and arranged manuals on the three important arms of the service, i. e., Bombardment, Observation and Pursuit, and besides has covered in the same form such subjects as Aerial Gunnery, Aerial Navigation, etc. These manuals are written for use as text books in training Air Service officers, and contain complete ground and flying curricula covering all subjects necessary in primary and advanced training to make finished pilots, bombers, observers and aerial gunners in all arms of the service. Arrangements have also been made to keep training data and methods up to date by liaison with other branches of the government and with the Air Ministry of our friends across the water.

In compiling these volumes, all the experiences gained at the front in actual operations against the enemy, and all the methods used at home and abroad for training the specialists necessary to successfully perform the strenuous duties at the front, have been carefully reviewed and assimilated. All unimportant data and obsolete methods have been eliminated and endeavor made in each case to segregate most approved methods and information, and to produce an interesting and highly instructive text book. The subject matter is presented in as clear and concise language as possible, with an attempt at verbosity. Three manuals form an integral part of the Government confidential file and are for official use only.

Licenses Not Needed

President Wilson has revoked the proclamation requiring civilian fliers to apply for permits to the Joint Army and Navy Board on Aeronautic Cognizance Board.

These licenses contained a clause stating "This license is not evidence of pilot's qualifications nor the reliability of aircraft used."

Function and Construction of the Rip Panel

By J. F. Boyle and E. F. Hurley

One of our most modern airships, the C-5, was lost by being blown away from its moorings. It was very unfortunate to lose it in this manner or in fact any manner, but it was particularly unfortunate that it should be blown away from its mooring place after having made such a remarkable flight from Rockaway to Newfoundland. There is no question that the flight was a remarkable one. However, there must have been a relaxation on someone's part after the flight when it came to mooring the ship.

The loss of the ship was apparently due to the failure of the rip panels to function properly. This must be the case if the reports of the incident were correct. These reports were to the effect that the moored ship was torn from its moorings and from its holding crew, while one of the crew tried to rip the panel, but failed. The ship was then carried out to sea. Since the main function of the rip panels in an airship are to prevent its being blown away in a storm, it is reasonable to attribute the loss of the C-5 mainly to the failure of the rip panels.

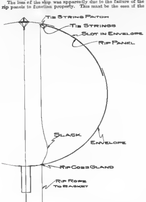

Fig. 1

Usually, when an airship is anchored in an open field, it is moored to a mooring post. The rip panel ropes are also tied to the mooring post, so that in case a storm arises and the ship is torn from its moorings the rip panels are automatically ripped and the bag immediately deflated. This saves the ship.

General Description

The rip panel is simply a slot cut in the gas bag with an extra piece of fabric cemented over the slot (Fig. 1). This extra piece of fabric called the panel, can be ripped off the bag, thus exposing the slot, through which the gas escapes (Fig. 2). The rapidity with which the gas escapes depends naturally upon the length of the slot and upon the location of the slot in the bag. The length of the slot varies with the size of the bag. This length is determined from practice. Moedebeck gives the length of slot in a spherical balloon as $\frac{p1}{3}$. This is one-sixth of the circumference of the bag.

The rip panel is operated by means of a rope called the rip cord (Fig. 2). This cord is tied to one end of the rip panel and extends either through the bag or along the outside, to the pilot's position. In the case of a spherical balloon the cord drops vertically through the bag, passing out through the bottom of it to the basket (Fig. 1). In order to relieve the panel of the weight of the cord, the cord is tied up to an anchor patch near the end of the panel (Fig. 2). This patch carries the weight of the cord. The tie string has a strength of about 30 lb. In pulling the rip cord the tie string must be broken first before the pull comes on the panel. The tie string is put on as a safety device so that in case a passenger in the basket steps on the rip rope or pulls it by accident, the strain will come on the tie string rather than on the panel, thus preventing an accident by ripping the panel.

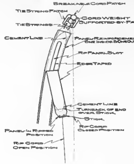

Fig. 2

Where the rip cord passes out through the bag some means of making the outlet gas-tight must be employed. The general method of accomplishing this is by means of a gland. Several types of glands have been tried out, but the one which is in use now consists of an aluminum flange with a rubber plug inside of it. The rip cord passes through the rubber plug. This forms a sufficiently gas-tight gland.

In an airship the rip cord is generally carried along the outside of the bag from the panel to the pilot's position.

The importance of the rip panel varies somewhat with the type of balloon. In the case of an airship the rip panels are only to guard against losing the ship in a storm while the ship is anchored or in some cases upon landing in a storm. In the case of a free balloon, the rip panel is employed at the end of each flight. It is ripped just before the landing, so that when the basket touches the ground sufficient gas will have escaped from the bag to prevent the balloon rising again off the ground. In the case of an observation balloon, that is, a balloon which is anchored to the ground by a cable, the rip panel embodies the functions of both the airship panel and the spherical balloon panel. It is intended to prevent the loss of the bag in a storm while anchored and it is intended also to be used in landing in case the balloon breaks away from its mooring cable and starts on a free balloon flight.

Types of Rip Panels

Spherical Type.—A spherical balloon rip panel is perhaps the most vital part of the balloon. Without it safe landings cannot be made, except under the most favorable conditions.

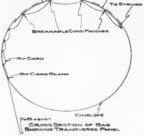

Fig. 3

On landing the panel is ripped and the bag deflated quickly. Enough gas rushes out immediately to prevent the balloon rising off the ground after it once lands. If this were not the case, the balloon would strike the ground and rise again, repeating this several times, depending upon conditions, with great danger to the passengers. Many cases of spherical accidents due to defective panels have been recorded.

Figs. 1 and 2 show a spherical rip panel of the type used in the latest Army and Navy sphericals. It is the outcome of gradual changes made from the experiences of many people and represents perhaps a very good type of spherical rip panel. Referring to Fig. 2, the slot cut in the envelope is 4 in. wide and varies in length from 12½ ft., for a small solo balloon, to 24½ ft. for a 77,000 cu. ft. balloon. This slot is taped over the edge with 2-in. balloon tape. This allows one inch of the tape on both the inside and the outside of the envelope over the edge of the slot, gives the slot a smooth edge and prevents fraying. It is also a reinforcement against tearing. Before the edge of the slot is taped, in fact before the slot is cut in the bag at all, two reinforcements of balloon fabric are cemented, one on the inside and one on the outside of the bag. The outside reinforcement is 10 in. wide and the inside 9 in. They are both longer than the slot. The slot is cut through these two reinforcements and through the bag itself and then it is taped. A double stitch is run all around the edge of the slot through the tape. This prevents the tape from becoming loose.

The panel itself which is cemented on to the balloon over the slot is made of two thicknesses of balloon fabric cemented together. The edge is taped, the ripping end of the panel is folded back over a toggle stick and this fold-back is cemented down.

The panel is cemented to the balloon for its entire width except where the slot is. The cementing toward the ripping end is brought to a point. This makes it easy to start the ripping.

Beyond the ripping end of the panel there is cemented to the balloon an anchor patch. The ripping end of the panel is tied to this patch by two breakable cords. These cords are of different lengths so that one breaks before the other. There is another small patch to which the rip rope is tied. This is an extra precaution.

Observation Balloon Type.—Figs. 3 and 4 show a type of observation balloon rip panel which comes to us from the French. There are eight holes cut in the envelope, these holes are elliptical rather than circular, so that the panel can be made comparatively narrow. The edges of the holes are reinforced with a rope grommet. There is a single reinforcement cemented on the bag before the holes are cut out. The panel itself is two thicknesses of fabric with the edge taped. The ripping end is turned back over a toggle stick. The ripping end is tied to the anchor patch with tie strings and the rip cord is tied to several breakable cord patches (Fig. 4).

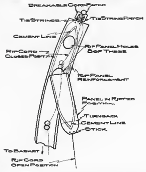

Fig. 4

There seems to be no advantages of this type of panel over the slot type. On the other hand there seem to be some disadvantages. The gas discharges much more slowly. This is a point of danger especially for spherical work. This fact was demonstrated recently at one of the balloon schools where a spherical was equipped by a contractor with an observation balloon rip panel. On landing, the gas escaped so slowly that the balloon was carried a great distance by the wind, dragging the basket over the ground before it finally stopped. This panel is much heavier and harder to rip than the standard spherical type.

Airship Types.—There are several different types of rip panels used in airships. The type to select depends upon several considerations. The first is the volume of the bag,

Fig 5

the second is the area of bag presented to the wind; the third is the length of the bag Considering the volume, it is obvious that the slot type of panel is the only one which would allow a fast enough escape of gas as to be safe. We might put a single panel which would be large enough to allow a fast enough escape of gas, but the chances are this panel would be so long that the balloon would be materially weakened at the panel point. Therefore we choose to put several shorter panels and distribute them around the balloon at the most advantageous points. Considering the great area of the balloon presented to the wind and the consequent ease with which a storm would rip the balloon from its moorings, it is obvious that there must be enough panels and of sufficient size to insure a rapid deflation. Considering the great length of the balloon, it is necessary that care be used in selecting the number of panels and their position on the bag

Fig 5 shows a type of airship rip panel The slot is constructed in much the same manner as that of a spherical rip panel. It is not so important to reinforce and tape the edge of the slot, since the panel is used so seldom The panel itself is cemented and stitched to the balloon, and is made of one thickness of two-ply straight fabric In straight fabric the threads in both plies run in the same direction. In diagonal fabric the threads in one ply run at forty-five degrees to those in the other At the ripping end of the panel there is a toggle stick A strip of panel as wide as the slot is ripped for a short distance, that is, the ripping is started Then the toggle stick is tied up to the anchor patch In operating the panel the fabric being straight fabric rips very easily. When the rip reaches the slot the pressure in the balloon finishes ripping it. A rip started in straight fabric in an airship, in fact in any balloon, will not stop until it reaches a cross seam This is why balloon fabric is made diagonal double, namely, to prevent long rips.

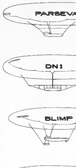

Fig 6

Location in Bag

In a spherical balloon the rip panel is located in the upper hemisphere The top of the slot is about 4 ft from the valve hole The slot runs in the direction of a meridian.

In an observation balloon the rip panel is toward the nose on top of the balloon. It runs transversely.

The problem of locating the rip panels in an airship envelope is rather complicated. What is desired is to get the gas out of the bag as quickly as possible when the panel is ripped. Hydrogen gas being sixteen times lighter than air, rises very rapidly, hence the best place to let it out of the bag is right at the top It is not easy to determine what part of the envelope will be on top when the panels are ripped or when the envelope is tossed about by a storm. It has been learned from experience that airship envelopes act differently under different conditions. The action depends a great deal on the direction of the envelope in reference to the wind direction. If the envelope is crosswise to the wind direction it will be over on one side or the other, as the case it is necessary to put rip panels on both sides If there are panels in one side only, the envelope might be on that side and cover up the slots.

If the envelope is headed into the wind, when it is ripped the wind will force the gas toward the rear, hence there must be one or more panels toward the rear

The planes and rudder at the rear being of great area are

Fig. 7

liable to cause the tail of the balloon to be whipped around It is well to have a rip panel placed among the planes so as to allow a quick deflation of the tail

If the bag lands with its tail head-on to the wind, the gas will be driven toward the nose In this case it will be necessary to have a panel in the nose to allow the gas to escape.

Fig 6 shows the location of the rip panels of various types of airships. The Parseval, which was a ship about 300 ft. long, had three panels, one straddling the nose and one on either side of the tail The DN 1, which we built for the Navy, was a much smaller ship—175 ft. long There were four panels, two forward and two rear on either side The Blimp, which was one of the later types built for the Navy, likewise had four panels, located in much the same position as DN-1. The last type we have proposed has two panels, one forward on the top of the balloon running lengthwise and one rear running transversely straddling the top It will be noted that the rip cords in this last type are inside of the envelope, whereas in each of the other types they are on the outside This is an advantage in reducing the wind resistance of the ship.

Fig 7 shows this type of balloon on the ground in process of deflation The nose end has already been deflated through the forward panel and the rear end is being deflated by the transverse panel which opens wide

It will be noted that the Blimp panels can be ripped from either end This allows the rip ropes to be tied to a mooring post when the balloon is anchored Ripping from either end is permitted by a simple arrangement of the rip ropes.

Causes of Failure

There are several reasons why rip panels fail Failures are due to carelessness, inexperience in handling, defective panels and mistakes in construction

A common failure is due to the panel tearing in two before it is ripped off the slot. This may be caused by Splice in the panel coming apart, a deteriorated panel, the turn-back on the ripping end not overlapping the cementing to the envelope, reinforcement on the envelope tearing with the panel, sewing the panel to the envelope with a lock stitch

Another cause of failure is the tearing of the envelope itself when the panel is being ripped off This may be caused by not bringing the cementing to a point at the ripping end or by improper reinforcements on the envelope.

Another cause of failure is having the panel on the wrong side of the balloon, in which case the panel is covered up when the envelope lies on the ground In a spherical balloon the panel should be on the same side as the drag rope. When the drag rope and anchor are thrown overboard and the anchor catches in the ground the balloon falls away from the anchor The panel being on the same side as the drag rope, when the balloon falls the panel is on top In the case of an airship the envelope might settle so as to cover up the panel.

Another cause of accident is illustrated by an incident which happened at one of our balloon fields. An observation balloon was hauled down and the panel ripped. The balloon was headed into the wind and the wind rushed in through the panel, mixed with the hydrogen, forming an explosive mixture which was ignited by static electricity The balloon was burned up If there had been a panel in the rear of the balloon, the gas would have escaped through it.

There are other causes of failure, such as breaking of the rip cord and tangling and knotting of the cord inside of the envelope Such cases are due to carelessness in inspecting the cords before flight

There are many small details which must be noted in order to prevent various failures of panels. Splices in the panel fabric other than the natural fabric splice must be eliminated. The splice is stronger then the panel itself and the panel is apt to fail on either side of the splice In applying reinforcements to the bag before cutting out the rip panel slots, if short pieces of fabric are used, the splices must lap over in the direction in which the panel is ripped off If the splices are against the direction of ripping, the panel will pick up the reinforcements as it passes over them

If a panel is sewed to the balloon in addition to cementing, a chain stitch must be used rather than a lock stitch

In spherical balloons a great deal of slack must be allowed in the cord inside of the balloon When the balloon becomes flabby it elongates in pear shape. If there is not enough slack in the rope the panel will rip itself

In re-applying the panel care must be taken to clean off the bag very thoroughly before putting the panel back on

From the foregoing description it is evident that the importance of the rip panel in any type of lighter-than-air craft cannot be underestimated. The fact that a balloon, excepting a spherical balloon, may live its whole life without ever having its panel ripped is no reason why proper precaution should not be taken in designing and applying the panel. When the rip panel is needed, it is needed badly

Novel German Transport Airplane

Fokker-Junker Six-Passenger Monoplane with All-Metal Fuselage Covered with Corrugated Duralumin. This Highly Interesting Machine Has, as May Be Seen, Internally Trussed Wings The Construction Affords a Clear View Forward and Sideways to the Pilot

(c) *International*

The Aeromarine Aerial Mail Delivery System

By Paul G. Zimmermann

As a means of expediting delivery of overseas mail, Mr. Otto Praeger, Second Assistant Postmaster General, recently ordered experiments to be made with a view to delivering mail by airplane to a ship at sea. Accordingly Postmaster Thomas A. Patten with the cooperation of David Lindsay of the International Mercantile Marine, and Inglis M. Uppercu,

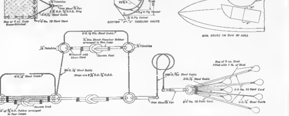

FIG 1 DETAILS OF THE AEROMARINE AERIAL MAIL CHUTE AND MAIL BAG

President of the Aeromarine Plane and Motor Co of Keyport, N. J., arranged that the experiment be undertaken on the White Star liner, Adriatic, sailing from New York on August 14, the Aeromarine Model 40 C flying boat being especially equipped and used for the attempt.

With this end in view Mr Uppercu started experimenting at his factory in Keyport. A number of plans were considered, but one, suggested by Mr Uppercu and thought most feasible by Pilot C J Zimmermann, consisted of trailing a weighted line about 200 ft. long from the flying boat. To the inner end of this line the mail bag was attached, the idea being to entangle the trailing line in the rigging of the steamer, the release of the mail bag taking effect as soon as the line became entangled.

FIG 2 AEROMARINE MAIL DELIVERY AT SEA

To try out this idea a 50-ft mast with guys, representing the rigging of a ship, was located on the beach at Keyport and for a week daily tests were made until the apparatus used in the actual attempt was developed. It was found at the outset that to entangle the rigging and make the "tie" hold, more than one weight would be required. The cat-o'-nine-tails with seven tails was therefore adopted, five of the tails being of sash cord and two of steel cable, each being weighted by a bag containing one and one-half pounds of lead shot.

The first attempt with this arrangement and a 100-lb bag resulted in the parting of the main sash cord line. The cord was then replaced by 5/32 in. cable and ⅛ in. strand rubber shock absorber. The trial resulted in breaking the shock absorber, a larger one being substituted for that broken and two other shorter and heavier shock absorbers added in the line, the line in this attempt being continuous to the bag.

The bag was located in a built-up veneer chute attached to the right-hand side of the hull of the flying boat at an angle of 15 deg. slanting to the rear, the bag resting in it and being held by friction until yanked from the opened rear by the cable catching to the rigging. Several attempts were made with this arrangement and the bag found to be too weak, having been made of a single thickness of canvas. A heavy reinforced bag was then made as shown in Fig. 1. Trials were then conducted and a remarkable efficiency developed, it being possible to hook the rigging on the stationary mast on every attempt, thus making a perfect score.

Considerable apprehension was, however, felt as to the results with a moving ship and this was by no means lessened by the fact that on the morning of Aug. 14 the weather was far from favorable. Mr Uppercu, however, decided to make the attempt, and at 1.30 p m., fully an hour after the sailing of the Adriatic, the flight was started. Mr Uppercu's yacht, the Lounger II, which was to be on hand to render any assistance necessary, had left the Columbia Yacht Club, New York, at 10.30 On board the yacht were Mr Uppercu, Mr E deB Newman, secretary of the Aeromarine Co., and a party of reporters and photographers. At 2.10 p m., or one hour and forty-five minutes after the sailing of the Adriatic, the mail boat was encircling the ship. A few seconds later the first attempt was made, the cat-o'-nine-tails catching the forward stay, as planned, and the mail bag dropped into the sea to be hauled aboard by the Adriatic's

sailors a few minutes later. Pilot Zimmermann made certain the mail was safely delivered and then flew home to Keyport. Thus the first attempt to put mail on board a moving ship had not only been accomplished but successfully performed under most adverse weather conditions.

Trade Reviews

CASCO WATERPROOF GLUE (Booklet received from Casein Mfg Co., New York)

This very interesting little booklet on the employment of glue in veneer is soundly technical and deserves very full notice.

The makers claim that their glue undergoes chemical

AVORIO-PRASSONE KITE-BALLOON, AN ITALIAN WAR DEVELOPMENT

Photo Western Newspaper Union

change on setting and is thereafter insoluble and therefore waterproof.

Large quantities of Casco glue were manufactured for the Aircraft Production Board, under whose supervision the following tests on the glue were made.

Boiling in water for 8 hr.
Baking at 150 deg. Fahr
Soaking in cold water for 10 days.
} Without the slightest separation

Minimum shear strength of 150 lb. per sq. in. on plywood.

With regard to strength requirements, the following tests are quoted from the Forest Products Laboratory reports.

Minimum . . . . 2270 lb. per sq in.
High . . . . 2770 lb. per sq. in.
Average . . . . 2556 lb per sq. in.

Casco is worked cold and is heat-resistant.

Instructions for mixing are as follows.

1. Pour into a mixer two pounds of *cold* water for each pound of glue.

2. Add the powdered glue to the cold water slowly, while agitating vigorously to prevent lumps.

3. Allow to stand for fifteen minutes, and use in spreaders or with brush, exactly as any other glue.

4. The mixed glue will keep for a full working day

Plywood made with Casco glue can be purchased flat and molded after steaming and soaking either between cauls or by nailing to braces. It will dry to original stiffness and retain its original shape.

The booklet gives the following sizes for standard panel construction

STANDARD PANEL CONSTRUCTION

Ply	Thick	F	C	B	
3	1/16"	1/40"	1/40"	1/40"	Not sanded.
		1/28"	1/60"	1/28"	For sanding
3	5/64"	1/28"	1/40"	1/28"	Not sanded.
5	3/32"	1/28"	1/28"	1/28"	Not sanded.
		1/28"	1/20"	1/28"	For sanding.
		1/20"	1/28"	1/20"	For sanding
3	1/8"	1/20"	1/20"	1/20"	For sanding.
		1/28"	1/16"	1/28"	Not sanded
5	5/32"	1/16"	1/16"	1/16"	For sanding.
		1/20"	1/16"	1/20"	Not sanded.
3	3/16"	1/16"	1/12"	1/16"	Allowance
		1/20"	1/8"	1/20"	For sanding
3	1/4"	1/12"	1/8"	1/12"	For sanding.
		1/16"	1/8"	1/16"	Not sanded
		F – X Bands.		C – V	
5	5/16"	1/16" 1/12"		1/16—1/16"	All for Sanding.
	3/8"	1/16" 1/8"		1/16—1/16"	
6	3/8"	6 —1/20" plies.			
9	1"	9 —1/8" plies.			
15	1"	15 —1/16" plies.		2 1/8" plies.	

In the drying of panels, the Bureau of Aircraft Production found that the best results were obtained by piling the panels carefully on trucks, using sticks of uniform size, being careful to place them directly under each other. Vertical guides on the trucks are of great assistance in piling properly and economically. Trucks should be placed close together and the dry room kept at from 105 to 115 deg. Fahr., with humidity of 45 to 55. A mild circulation should be maintained, preferably induced by electric fans, which would be set so as to blow against baffles and not directly against the stock. It was found that by using this method, three-ply 1.4 in. panels would come down to about 12 per cent moisture content in from 24 to 48 hr.

Each plant has its own drying problem, determined largely by its dry room facilities, and the Casco makers will be glad to make suggestions upon request.

The following table may be of use to designers using plywood made with this glue:

MOISTURE CONTENTS OF SPECIMENS ABOUT 12% TABLE IS APPROXIMATE

Thickness.	Faces. Thickness & Kind of Wood.	Core. Thickness & Kind of Wood.	Weight. lb. per 100 sq. ft.	Strength in lb. per inch with face grain.	Strength in lb. per inch across the grain.
1/8"	1/28"	1/16"			
	Birch	Basswood	44	1,200	700
	Birch	Poplar	45	1,250	950
	Birch	Maple	53	1,300	900
	Birch	Birch	54	1,350	1,175
	Maple	Basswood	40	900	450
	Maple	Poplar	43	950	650
	Maple	Maple	48	1,000	780
	Maple	Birch	53	1,050	980
1/4"	1/16"	1/8"			
	Birch	Basswood	76	2,200	1,300
	Birch	Poplar	79	2,350	1,500
	Birch	Maple	94	2,400	1,750
	Birch	Birch	83	2,550	1,800
	Maple	Basswood	74	1,450	300
	Maple	Poplar	78	1,600	450
	Maple	Maple	83	1,750	950
	Maple	Birch	88	1,850	1,300

It is interesting to see that glue manufacturers are now using all the scientific methods available and are gradually departing from empirical methods.

PAMPHLETS FROM AMERICAN SHOP EQUIPMENT CO., A Furnaces—8 pp.—Shop Furnaces 7 pp. Both illustrated. The catalogues describe standard sizes of furnaces for annealing, hardening, tempering and case hardening, and other similar equipment. They should be useful for engineers considering heat treatment installations.

BULLETIN NO. 22, received from the Wellman-Seaver-Morgan Co., Cleveland, Ohio, gives a chart establishing relations in any shaft between Power, Shaft Diameter, Torsional Stress and Speed. This chart is very useful and can be obtained from the company.

Testing Water Resistant Plywood Glues

By Clyde H. Teesdale
Engineer in Forest Products

and R. A. Colgan
Industrial Examiner in Forest Products

The importance of plywood for use in airplane construction was recognized in the United States immediately upon the adoption of our aircraft construction program. It was also realized that in order to be suitable for the purpose and reliable under various conditions of exposure the plywood should be made with water resistant glue. Water resistant glues were known to some extent previous to this time, but they had not found extensive commercial use in this country, and there was little scientific information about their preparation or use, or methods of testing them. This information was necessary, however, in order to encourage the production of water resistant plywood in sufficient quantity, and to insure a quality satisfactory for airplane construction.

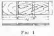

Fig 1

At the request of the Signal Corps the Forest Products Laboratory in 1917 undertook to secure this information and to develop methods of testing water-resistant glues which would permit the necessary inspection and control of the plywood with a minimum of inconvenience and effort.

In making the preliminary study of the properties of water-resistant glues in 1917 the following tests were used:

1—Soaking in cold water for two weeks.

2—Baking in an oven for 24 hr. at 212 deg. Fahr.

3—Boiling in water for 24 hr. followed by baking as above.

4—Hanging in a room with about 100 per cent humidity for one month.

5—Exposing to the weather with and without protective coatings.

These tests were very useful in distinguishing between resistant and non-resistant glues, and helped to eliminate from further consideration a considerable number of glues for which water-resistance was claimed. They served very well until it became necessary to draw specifications for water-resistant plywood and provide means of inspection which would insure the necessary strength and water-resistance of the glue without delaying production.

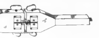

Fig 2

For this purpose, tests Nos. 4 and 5 listed above were unsuitable because they required too much time. Both continued to be used to some extent, however, in studying the properties of the glues. Test No. 2 was abandoned as it was found to give little information. Tests Nos. 1 and 3 were retained in modified form as being particularly useful for control work.

It was found that the length of the boiling test could be reduced to 8 hr. and still give the information desired. The reduction permitted the test to be completed the same day it was started. For a time the plywood after being boiled was redried to about 10 per cent moisture before its condition was recorded, but this was found unnecessary and was abandoned in order to save time. The soaking test was reduced from 2 weeks to 10 days as this length of time was found sufficient to give the information desired.

Great objection was encountered when the boiling test was first suggested by the Forest Products Laboratory as a control test. The recommendation was firmly adhered to, however, and finally incorporated in the specifications. It never was considered by its sponsors as providing conditions comparable to those to which an airplane might be subjected. It was considered simply as an accelerated soaking test, giving information within a few hours which would require several days or weeks to obtain by soaking in cold water or exposure to high humidity. Many tests made since its adoption have shown that this is true. When the 8-hr. boiling and 10-day soaking tests are made on samples from the same panel, the boiling test is generally found to be the more severe. It is, therefore, a safe substitute for soaking when speed is important.

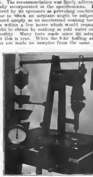

Fig 3

In addition to the water resistance it was necessary to know the strength of the glue joint. It is a simple matter to get data on the shearing strength of glue joints in thick laminations such as propeller joints, and to make a direct comparison of this with the shearing strength of wood, but an entirely satisfactory test for the strength of glue in plywood has not yet been discovered. So far the test specimen which has been found most satisfactory from the standpoint of simplicity, ease of preparation, and rapidity of test is one that was adopted by the British Government. This specimen is shown in Fig. 1.

The specimen is tested by placing it under tension in a cement testing machine provided with special grips instead of the ordinary briquette holder, as shown in Figs. 2 and 3. The specimen fails principally from shearing, but on account of the slight eccentric loading due to the form of the specimen other stresses enter to a certain extent and the values obtained are not as high as if the failure were due entirely to shear. The test served very well, however, because it gave comparable results quickly and enabled a close check to be kept upon the strength and uniformity of the plywood produced with various glues in different factories.

Another test which was suggested by an aircraft factory was a so-called bend test. Plywood up to 3/16 in. thick was required to stand bending over an arc of a cylinder with a

9 in. radius, without failure in the glue or the wood. Plywood from 3/16 to 5/16 in. thick was required to stand the same test over an arc of 12 in. radius. It was not specified whether the bend should be made with the grain of the face plies parallel or perpendicular to the circumference of the cylinder, although there is a great difference in the flexibility of plywood in the two directions. The test gave practically no information and was little used.

The Bristol Coupé and Hydro-Airplane

The design of these machines follows very closely that of the Bristol Fighter which proved so successful during the war. The inherent stability of the Fighter and its remarkable successes in aerial encounters on the allied fronts in France, Italy, Egypt, Palestine and Salonica are widely known.

The Bristol Coupé is designed as a tandem two-seater, pilot forward, or as a three-seater, two passengers side by side, pilot forward.

Three-Quarter Rear View of the Bristol Coupé

In consideration of the comfort of the passengers, easy chairs are placed in a totally enclosed cabin fitted with triplex glass windows on either side and affording complete protection from wind, rain, etc. An air speed indicator and altimeter is fitted in the cabin as a matter of interest to the passengers while in flight.

The Coupé may be fitted with any of the following engines: Hispano Suiza, 150, 180 or 300 hp., Hall-Scott L6 225 hp., Rolls-Royce Falcon 11 264 hp., or Siddly Deasey Puma 240 hp.

A large radiator is fitted to insure satisfactory cooling under constant service.

The Bristol Coupé has a cruising speed of 105 m.p.h. This speed is recommended in view of the fuel economy. Fuel capacity permits of 400-mile flight at an altitude of 5,000 ft.

The following are the performances: speed, ground level, 125 m.p.h.; 5,000 ft. 122 m.p.h., 10,000 ft. 113 m.p.h.; climb 6,000 ft. 5¼ min., 10,000 ft. 11½ min., 15,000 ft. 21½ min.

The following are weights and dimensions: weight, empty, 1,750 lb.; weight loaded 2,800 lb.; wing span 29 ft. 3 in., chord 5 ft. 6 in., overall length 25 ft. 9 in., maximum height 10 ft. 1 in., wing area 405 sq. ft.

In the event that mail or freight is carried in place of passengers a load of 450 lb. can be carried with full fuel capacity for a 400 mile flight. The space available for cargo is 23 cu. ft. An improved form of dual control is installed so that either pilot or passenger may fly the machine with equal comfort.

This type of machine should prove especially attractive to those desiring a high-class machine combined with performance and reliability for tourist travel or for passenger-carrying and exhibition purposes.

The Bristol Hydro-airplane in design is practically the same as the Coupé with the exception that two main floats are provided in place of the undercarriage. The floats are each divided into four water-tight compartments and are of such length that a tail float is rendered unnecessary. Water rudders are attached to rear of floats.

For commercial purposes the machine can carry a load of 300 lb. in addition to passenger and pilot and fuel and oil sufficient for 4½ hours flight. In cases where the pilot only is necessary, the useful load of the machine is 500 lb. and fuel and oil sufficient for 4½ hours flight.

The machine has a speed of over 90 m.p.h. and lands at 47 m.p.h. Climb to 3,500 ft. is made in 7 min., 6,500 ft. in 18 min. The hydro-airplane may be fitted with any of the engines mentioned in connection with the Bristol Coupé.

Naval Speed Record

Naval speed records for pontoon seaplanes were broken recently by an H-A fighter in which Lieutenant-Commander N. H. White, Jr., U. S. N., commanding officer of the Naval Air Station, Hampton Roads, and Lieut. L. T. Barin, pilot, made a trip from Hampton Roads to the Naval Aircraft factory at Philadelphia. The course covered was approximately 270 miles and the time 135 minutes, or at the rate of two miles per minute.

The H-A fighter is a recent design in connection with the work of the Bureau of Construction and Repair, and it is believed to be the fastest pontoon seaplane in existence. It is equipped with a Liberty 12-cyl. 335-hp. motor and under favorable conditions will make 120 to 130 m. p. h.

It was constructed by the Curtiss Engineering Corp. at Garden City, Long Island.

During this flight the weather conditions were slightly unfavorable. Gusty side winds and fog banks were encountered and the visibility was very low. The flight was made at 1,500 ft. altitude, except when crossing from the head of Chesapeake Bay to Delaware River, when the altitude was raised to 4,500 ft.

Rules of the British Seaplane Competition

The seaplane competition which the British Air Ministry has decided to hold simultaneously with the airplane competition,* that is, beginning March 1, 1920, will be open to float and boat type seaplanes and engines constructed within the British Empire, although secondary equipment may be of foreign origin. The purpose of the competition is to ascertain the best types of float seaplanes or flying boats in which it will be safe to travel, and which in particular will be capable of alighting on and rising from land as well as water.

Unlike the airplane competition, the seaplane competition will be open to but one type of machine, namely, a seaplane of either float or boat type provided with seating accommodation for four persons exclusive of the crew. Machine must fulfill all conditions required for a certificate of airworthiness—as laid down in the British Air Navigation Act, 1919—and must carry parachutes and lifebelts for all persons for whom accommodation is provided, including the crew. The boat or floats must be so sub-divided that if perforated on any one part each float still retains positive buoyancy.

Competing machines must have a minimum high speed of 80 knots (92 m.p.h.), and a maximum low speed of 40 knots (46 m.p.h.) with full load at sealevel, and must be capable of climbing not less than 350 ft. per min.

Alighting and Getting-Off Tests

(a) Getting-off test (sea).

Machines will be required to take off with full load, and clear an obstacle 25 ft. above sea level in a distance not exceeding 300 yd. from a position of rest.

(b) Alighting test (land).

Machines will be required to land on a smooth aerodrome over an obstacle 25 ft. in height and to come to rest in a distance not exceeding 400 yd., measured in a straight line from the point where the obstacle is crossed. For this test machines will be required to carry full load less 50 per cent total and oil.

(c) Getting off test (land).

Machines will be required to take off a smooth aerodrome with full load and clear an obstacle 25 ft. in height in a distance not exceeding 400 yd. from a position of rest.

(d) The above tests are to be made in still air, which for the purposes of this competition will be regarded as any wind velocity not exceeding 5 statute miles per hour.

(e) During landing the machine is not to side-slip nor to turn after reaching the obstacle until it is on the ground. Once it has touched the ground the machine may turn in any direction.

(f) No braking device operated by the engine may be used during landing.

(g) Any landing or taking off gear used must be integral with the machine.

(h) No landing apparatus may be used which in the opinion of the judges would be liable to cause undue damage to an aerodrome.

(i) In test (a), (b) and (c) above, machines will be allowed four attempts, of which two must be successful.

Test of Reliability in Flight

Each machine must carry out a flight of five hours at a speed through the air of not less than 70 knots, starting with full load.

Pilots may be changed during this flight.

Seaworthiness Tests

(a) *Fair weather.* Each machine will be moored to a buoy by its own crew, and using its own mooring tackle (other than the buoy and its moorings) for a period of 24 hours, during the first 23 hours of which time it will be left unattended. The crew will not be allowed on board to pump out the bilges at any time during this test except with the permission of the judges in case of emergency.

At the conclusion of the 24 hours period the crew will be allowed on board; the machine will be got under way by its own crew and under its own power, and will be required to carry out a short flying test within a period of one hour from the conclusion of the 24 hours period.

The test will be carried out under fair weather conditions. Marks will be allotted for rapidity in getting under way.

(b) *Moderate weather.* Each machine will be moored to a buoy for a period of not less than 12 hours, unattended, under the following conditions:

Locality—Roadstead sheltered from the open sea.

Wind—From 4 to 6 on the Beaufort Scale.

Marks will be allotted for the general condition of the machine at the conclusion of this test, and its behavior during the test.

In both the above tests the ordinary average tidal currents existing round the coast of the British Isles may be experienced.

Rough water getting off and alighting test.

Each machine will be required to carry out a test of getting off and alighting on disturbed water, which in the opinion of the judges constitutes a moderate sea. The condition in any case will not exceed state 4 in the sea disturbance scale. (Waves under 4 ft. in height.)

Machines will be required to carry out a test of being towed in a moderate sea as defined in para. (9) in a circle of approximately one-half mile radius.

Each machine must make a figure of eight course round two buoys 100 yd. apart, and within a rectangle measuring 200 yd. by 100 yd. in a wind not exceeding 15 m.p.h., the sea to be smooth and the tide at slackwater.

Each machine must be capable of moving on the water, under its own power, for a period of at least 30 min. and at a speed of not less than 10 knots and not greater than 20 knots.

Miscellaneous Divisions

Each machine will be required to carry an anchor and sea anchor, as well as the own mooring tackle, and to anchor on good holding ground with its own gear and remain fast in a wind of 10 m.p.h. and with tidal current not exceeding 3 knots.

In a machine having two or more engines, the stoppage or retardation of one engine must not cause the machine to get out of control.

Machines must be capable of flying at cruising speeds for 3 min. without the use of any control or stabilizing devices. Controls may be locked during the test.

Machines, in the round flying position, must take up and maintain a gliding angle, when the engine or engines are cut off without the use of any controls or stabilizing devices.

After stalling (1) machines must be capable of recovering flying speed and complete control without a loss of more than 500 ft. in height.

Machines must be capable of being started from the cockpit or cabin, without undue muscular exertion.

Marks will be awarded for soundness and quality of construction, for general features, for general behavior afloat, and for exceeding the specified requirements.

Soundness and quality of construction will include:

(a) Fire protection, including use of self-sealing tanks, position of tanks (from the point of view of safety from fire in event of a crash), fire-fighting appliances and accessibility of same.

(b) Reliability of fuel, oil and water systems, and facilities for seeing if all tanks are full.

(c) Durability of machine, including propeller (any advantages due to metal construction may be taken into account).

(d) Simplicity of design and accessibility of parts.

(e) Absence of vibration in the machine.

(f) Ease of repair, especially in regard to the hull or floats.

General features will include:

(a) Efficiency and ease of control.

(b) Unrestricted field of view to the point for the pilot.

(c) Silence as affecting occupants of the machine.

(d) Comfort generally, including warmth.

(e) Self-starting devices.

(f) Convenience of mooring and anchoring arrangements.

(g) Method of wind screening adopted.

(h) Convenience for use of instruments.

(i) Freedom of entering and exit for occupants.

(j) Bilge pumping arrangements.

Behavior afloat will include:

(a) Stability at rest.

(b) Water stability at all speeds.

(c) Minimum spray at all speeds.

Marks will be allotted for exceeding the minimum high speed and flying less than the maximum low speed.

The judges will have regard to the method of fitting parachutes, and especially to the means of exit by parachute afforded to the occupants, and will allot marks for the same.

Full load will include, beside the instruments specified in the rules of the airplane competition, a sextant, fuel and oil sufficient to fly 450 nautical miles (517.5 statute miles) at 1,000 ft., and a load of 1,000 lb.

During or on completion of any flying test, if it is necessary to effect any repairs to the machine after alighting, it will be considered to have failed in that particular test.

The British government agrees to buy the machine winning the first prize, the design to remain the property of the manufacturer, at a maximum price of £8,000. The following prizes will be awarded to competitors: First prize, £10,000; second prize, £4,000; third prize, £2,000.

* See Oct. 1, 1919, issue of AVIATION AND AERONAUTICAL ENGINEERING.

Book Reviews

A GLOSSARY OF AERONAUTICAL TERMS. 100 pp. Royal Aeronautical Society.

The Technical Terms Committee of the Royal Aeronautical Society, headed by Lieut.-Col. Mervyn O'Gorman and having for members representatives of every important aeronautical body in Great Britain, has just been issued.

It is the most complete effort of its kind ever attempted and deserving of the most careful attention, although the Committee very modestly terms the glossary a working compromise.

The basis of the provisional glossary is as follows:

(a) The coinage or creation of new terms has been avoided.

(b) Terms which, though used in aeronautics, have the same sense as in their ordinary usage, have been excluded with few exceptions.

(c) When current usage has been lax a term has been restricted to that employment which was either dominant or most logically defensible.

(d) Terms already in common use have been crystallized by clearly defining their application.

(e) Cross references have been given to many colloquialisms which have a reasonably wide use, but formal status has not been given to them.

(f) An agreed series of symbols has been introduced for those mathematical calculations which relate to aerodynamics.

(g) Terms of which the meaning in aeronautics has been narrowed down to some specialized significance have usually been included.

(h) The names used in aircraft stores of parts and materials have been listed and defined where necessary.

(i) Meteorology and its terms have been included as a part of the science of aeronautics.

A very serious attempt is also made to standardize a system of aeronautical symbols.

A good deal of work was done on correlating the popular names of timber to their scientific nomenclature. In aero-engines the recommendations of the Automobile Nomenclature Committee of the Engineering Standards Association have been mainly adopted.

The Glossary is based on a universal system of decimal classification offering the possibility of unlimited extension and with which it is possible to cover not only every possible phase of aeronautics, but every branch of human knowledge.

The main headings of the Glossary include:

General Physics.
Ballistics, Hydrometers, Atmosphere, Barometers.

Aeronautics.
Aerodynamics in General.
Dynamics of Lighter-than-Air Craft.
General Dynamical Theory of Airplane Motion.
Symbols.
Air Screws.
Magnetism Compasses.

Meteorology.

Aircraft Internal Combustion Engine.
General Theory.
Aero Engine Components.

Locomotion by Air and Aircraft.

Lighter-than-Air Craft.
Component Parts.
Envelope, Rigging, Body, Nacelle, Engine Installation, Tank and Pipe Installation, Armament Installation, Accessory Instrument and Electrical Installation.

Heavier-than-Air Craft.
Component Parts.
Body Engine Installation.
Tank and Pipe Installation.
Armament Installation.
Accessories. Main Planes. Tail. Controls. Flying. Under-carriage. Instruments.

Aerial Navigation.
Timber Names.

Lighter-than-Air Aircraft.—The most important definition is perhaps that of disposable lift: "The lift available for fuel, stores, etc., after the aerostat has on board the crew and all gear essential for flight." This seems a reasonable settling of a disputed question.

General Dynamical Theory of Airplane Motion.—The committee has given considerable thought to the question of axes. This question has been a most puzzling feature in all theoretical work on the airplane. In the best known system of coordinate axes employed hitherto the flight of speed of the airplane is a negative quantity with the x axis measured positive in a direction opposed to the flight-direction. This is contrary to physical conceptions. In the system recommended by the committee a right-handed system is employed, with the x axis positive to the right and z vertically downwards. With this system the flight speed of the airplane in normal flight, the angle of incidence, the thrust of the airscrew and the weight of the airplane are positive. A positive bank corresponds to a positive turn. The air resistance and forces in the aircraft, including the lift, are negative. The rate of climb is negative. This is a very fair compromise and one which mathematicians will readily adopt.

The glossary includes a complete list of symbols for use in the general dynamical theory. This system of symbols introduces but very few deviations from current practice. Greek letters are unfortunately introduced for angles and perhaps a few unnecessary symbols are included, but on the whole this is the best and most comprehensive system yet devised. It would be a very desirable thing if this system of symbols were immediately adopted in all English speaking countries.

Absolute Coefficients.—Absolute coefficients for forces and moments have not been employed to any large extent in either American or French work, but British laboratories have used such coefficients almost exclusively. Coefficients are given in the glossary for Lift, Drag, Thrust, Longitudinal Force, Normal and Lateral Force, Torque, Rolling Moment, Pitching Moment and Yawing Moment. These are familiar to American readers, but an extension to resistance derivatives is made in the report.

While forces and moments vary as the density and the square of the speed, resistance derivatives vary as the density and the first power of the speed, so that the absolute coefficient is defined by an equation such as

$$mX_u = K_{xu}\rho SV$$

A very neat table is given indicating the dimensional values of all resistance coefficients.

Stability.—The definitions given here are extremely valuable, defining movements about which there is considerable conflict of opinion. Thus:

"Spiral Instability—The instability on account of which an aeroplane tends to depart from straight flight, by a combination of sideslipping and banking, the latter being always too great for the turn."

A truly excellent definition.

"Subsidence.—A disturbance which dies out without oscillation," which is new to us. As is also:

"Divergence—A disturbance which increases without oscillation."

Meteorology—The definitions under this subheading are a powerful aid to anyone interested in, but not too familiar with, the subject.

Lighter-than-Air—In aerostatic work a great many parts are always loosely defined and the Glossary will do much to remove confusion by systematizing the principal terms.

While these terms are on the whole well chosen, exception might be taken to the definition of the term *ballonet*—"the air containing portion of an envelope"—for not being sufficiently explicit. This objection, though not obvious at first sight, becomes apparent in view of the definition given to the term *envelope*. This is defined as "the outer fabric cover of an aerostat," which constitutes a departure from current practice, where the fabric cover of non-rigid and semi-rigid airships is called *envelope*, and that of rigids is termed *outer cover*. This change is commendable because it marks a simplification, in this case, however, the definition of ballonet is not sufficiently explicit, because on rigid and on some semi-rigid airships there is an air space—sometimes called ring-space—inside of the envelope (or outer cover) which does not of necessity function as a ballonet, although it is so used in certain ships.

By the way, though *ballonet* is a very widely employed term, the question arises whether it would not be advisable to use instead a more generic term, such as *air chamber* or *air cell*, the more so as in every likelihood rigid airships will eventually be constructed of a rigid shell where the necessity of a flexible fabric ballonnet will be obviated. Likewise, *gas chamber* might be substituted in this case for *gas bag*.

Parts of the Airplane.—The definitions relating to the main planes are open to criticism. Thus,

"Gap—The distance between the top and bottom main supporting surfaces of a biplane. For specific purposes the precise points between which it is measured should be indicated."

This is a confession of indecision. It is just to such a committee that one would look for a definite ruling.

The same remarks apply to the definition of stagger.

The definition of ailerons is given as "aerofoils used for causing an aeroplane to roll about its longitudinal axis for the purpose of balancing," and is not at all definite. Where the ailerons are attached, and how attached, could be covered by the definition.

In speaking of anti-lift wires the glossary says: "Wires intended mainly to resist forces in the opposite direction to lift." Mention should have been made of the fact that these wires come into action in upside down flying and in landing.

The glossary has an excellent index and some useful illustrations in connection with engine parts and main structural parts of the airplane.

Course in Aeronautical Engineering

Since Oct. 2 a series of evening lectures on the theory and practice of aeronautical engineering are being delivered at the Brooklyn Polytechnic Institute by Alexander Klemin, consulting aeronautical engineer. These lectures deal with the fundamental principles of aeronautics, to be followed by the practical application of the principles to airplane construction and design.

They will not be too far advanced in character, but, as far as possible, technically sound.

This course should be of interest to airplane draftsmen and to others in the industry. For further particulars, apply to the Director of the Evening School, Brooklyn Polytechnic Institute, Brooklyn, N. Y.

Chicago Aeronautical Show

The first aeronautical exposition next year will be held in Chicago the week of Jan. 8 and will be the first show of its kind ever to be held outside of New York. Exhibitors are preparing to display a variety of 1920 airplanes, the designers of which have anticipated the wants of prospective customers among the rapidly increasing numbers of private owners. The evolution of the airplane from war to peacetime models will be one of the features of the show.

The executive committee in charge of the show has established headquarters in the Congress Hotel, Chicago.

ONE OF THE AIRCO (D. H.) MACHINES EMPLOYED IN THE DAILY LONDON-PARIS PASSENGER AND EXPRESS SERVICE RECENTLY INAUGURATED
(c) *Underwood & Underwood*

The Schneider International Seaplane Cup

SAVOIA FLYING-BOAT FLOWN BY JANELLO—THE VICTORIOUS ITALIAN ENTRY
(c) *Keystone View Co*

The annual competition for the Jacques Schneider International Seaplane Cup, which had not been held owing to the war since 1913, when it was won for Great Britain by a Sopwith seaplane flown by Howard Pixton, took place on Sept. 10 at Bournemouth, England. Out of seven entrants—three British, three French and one Italian—only one, the Italian, finished the race, but as he did not cover the prescribed course owing to an error of judgment the race was declared void by the Contest Committee of the Aero Club of Great Britain.

The race was run over a triangular course of 20 nautical miles, and the contestant covering ten laps in the shortest time was to be declared winner. The turning points of the course were marked by marking boats, carrying observers to ascertain that each contestant properly followed the prescribed course. The three competing nations were represented as follows:—

Great Britain—Sopwith seaplane, 450 hp. Cosmos-Jupiter (radial) engine, 210 sq. ft. wing area, 2,200 lb. gross weight; Fairey seaplane, 450 hp. Napier engine, Supermarine flying boat, 450 hp. Napier engine, 360 sq. ft. wing area, 2,900 lb. gross weight.

France—Two Nieuport seaplanes, 300 hp. Hispano-Suiza engine, 240 sq. ft. wing area, Spad seaplane, 300 hp. Hispano-Suiza engine, 280 sq. ft. wing area, 2,400 lb. gross weight.

Italy—Savoia flying-boat, 250 hp. Isotta-Fraschini engine, 350 sq. ft. wing area, 2,797 lb. gross weight.

A FRENCH ENTRY FOR THE SCHNEIDER CUP; THE SPAD FLOWN BY S. LECOINTE
(c) *Keystone View Co*

On the day of the race there was a light haze, with no wind at all and a dead calm sea, and this precisely caused the undoing of the majority of contestants. Owing to the absence of wind all the machines had to alight at their slowest safe flying speed, and that on a sea that was as smooth and as hard as glass; consequently the extra light floats of the racing seaplanes which would have functioned satisfactorily on a fairly windy day simply cracked upon hitting the smooth sea at a high rate of speed. Some of the seaplanes stove holes into their floats upon being beached, while others hit drift wood while taxi-ing; thus all but the Italian entry, the Savoia flying-boat piloted by Janello, were eliminated. The latter covered the prescribed ten laps, but seems to have consistently turned around a boat stationed in the vicinity of one of the mark boats instead of around the latter, whereupon the Contest Committee declared the race void. The Italian representatives appealed against this decision and lodged a protest against the manner in which the race was managed.

Army and Navy Balloon Race

A free balloon race between representatives of the Army and the Navy, under the auspices of the Missouri Aeronautical Society, was held on Sept. 26, 1919, starting from St. Louis, Mo. Three balloons were entered representing the Army and three representing the Navy, each of 50,000 cu. ft capacity, using coal gas and each carrying one officer as pilot and one as aid. The object was to cover the greatest distance in any direction from St. Louis, and time was not a factor in the contest.

Of the Navy balloons, one was unable to leave the park, owing to a leaking bag, one landed at Menas, Mich., and the other, piloted by Lieut. Emerson, landed at Stittsville, Mich. Of the Army balloons, one was forced to land in the heart of St. Louis, after 20 minutes flight, another landed at Green Bay, Wis.; and the third, piloted by Captain E. P. Phillips, with Lieut. B. T. Burt as aid, landed in the waters of Lake Michigan, off Death's Door Bluff, just north of Dorr Peninsula.

The agreement was that in each on event the point on the shore line crossed just before reaching the water was to be taken as the end of the race, so that the farthest point credited to the Army balloon is the northernmost tip of Dorr Peninsula, and it appears from the incomplete information at hand that the result is practically a tie between Lieut. Emerson, of the Navy, and Captain Phillips and Lieut. Burt, of the Army. The officials of the Coast and Geodetic Survey are computing the exact distance and to date the official announcement of the winner has not been made.

Long Seaplane Flight

A remarkable demonstration flight to the Scandinavian countries was recently carried out by F. 5, Flying Boat N. 4044, of No. 4, Communication Squadron, R.A.F. Starting from Felixstowe and proceeding via Dundee, the machine flew direct to Norway and landed at Christiansand; thence the trip continued in stages to Christiania, Copenhagen, Stockholm, Goteborg, Esbjer and back to Felixstowe, a total distance of 2,450 sea miles, which was covered in a total flying time of 40 hours 40 minutes.

The flight was made entirely as a demonstration of the commercial uses of flying boats, and is noteworthy because no mishap occurred of any kind, despite the fact that from its departure until its return to Felixstowe, the machine spent a total of twenty-seven days in the water or in the air.

Scandinavia is perhaps the best market in the world for watergoing aircraft. Very few land aerodromes exist in these countries, and the land lying between them is difficult and generally dangerous for alighting. On the other hand sheltered stretches of water are found everywhere and there are numerous natural seaplane harbors. Practically the whole of Norway is navigable by seaplanes making use of the fiords, and in Denmark all the large towns are approachable by water; in Sweden a natural seaplane highway extends right across the country, formed by the two large lakes Vattern and Vanern, the Gotha Canal, and countless small lagoons and lakelets.

New World Records

Four new world records have recently been established by American pilots.

A new official world's altitude record for pilot and one passenger was made at Dayton, O., on Sept. 6, when Maj. Rudolph W. Schroeder climbed to 28,500 ft. in a LePere biplane equipped with a 440 hp. Liberty motor.

Major Schroeder's new record was made possible by the new airplane engine super-charger, originated during the war but never perfected until recently, and which practically doubles the efficiency of an airplane engine at high altitudes.

The LePere biplane, equipped with Liberty motor, which Major Schroeder used in the altitude flight, has a horizontal speed at sea level of 136 m.p.h. At an altitude of more than 20,000 ft., this speed, owing to the rarity of the atmosphere and the decreased engine power, falls to 105 m.p.h. Equipped with the super-charger device, the horizontal speed at 28,250 ft. was maintained at over 130 m.p.h., or almost equal to the best possible at sea level. Major Schroeder found that the compressor consumed but 5 or 10 per cent of the engine's horse power, while, at 15,000 ft. altitude it added 40 per cent to the power-plant's effectiveness, at 20,000 ft. 48 per cent was added, and at 28,000 ft. 60 per cent was gained. The super-compressor, simply described, is a device to utilize the waste exhaust gases of the engine itself to operate a small centrifugal air-blower which forces a combustible air steam into the engine at a constant pressure about equal to the normal suction of the motor at sea level pressure, and thus maintains engine functioning approximately the same as under the best conditions at sea level.

Major Schroeder and his passenger wore electrically-heated clothing and oxygen helmets. The record shows that the temperature at 28,25 feet was —29 deg. cent.

On Sept. 18, Roland Rohlfs, test pilot for the Curtiss Engineering Corp., flying a Curtiss "Wasp" fitted with a Curtiss 400 hp. engine, ascended to an altitude of 34,610 ft., thus establishing a new world altitude record for pilot alone and breaking his own unofficial record of 34,290 ft. which he made five days previously. The entire flight consumed 1 hr. 53 min., 78 min. of which was taken up by the climb. No supercharger was used in this record breaking flight.

On the following day Rohlfs established with the same airplane a new climbing record by climbing 19,750 ft. in 9 min. 42 3-5 sec. The Curtiss "Wasp," a two-seater fighter designed for the U. S. Navy, also holds the official world speed record with 163 m.p.h., this was made last year under government supervision at McCook Field, Dayton, Ohio, and in making it the "Wasp" carried its designed military load consisting of four machine guns and 1,100 rounds of ammunition.

On Sept. 29 Caleb Bragg, pilot, and Cols. Younger, observer, flying a Loening hydro-monoplane fitted with a 300 hp. Hispano-Suiza engine established at Port Washington, L. I., a world altitude record for seaplanes by ascending to 18,500 ft.

This record as well as that made by Major Schroeder has been homologated by the American Flying Club; Rohlfs' record is awaiting homologation by the Aero Club of America pending the certification of his barograph record by the Bureau of Standards.

A Letter

Editor, AVIATION AND AERONAUTICAL ENGINEERING:—In my article entitled "Airship Engineering Progress in the United States" in your issue of Sept. 1, 1919, I gave the impression that the kite balloon cable with telephone core developed in the United States during the War was satisfactory. I believe, however, that this is apt to be misinterpreted as the cable can be considered satisfactory only relatively to the foreign cable. While the cable did give a certain amount of service there has been always considerable difficulty from broken conductors if the cable by any chance got kinked or abused. From the standpoint of progress this cable marked a certain stage of the development, but we are not at all satisfied with it, and are taking steps now in cooperation with the manufacturers to develop an improved type of armored insulation which it is hoped will give a longer life to the telephone conductors in the core.

J. C. HUNSAKER,
Comdr. (C. C.), U. S. N.

Housing the Airplane

By E. L. R. Grimsley
Chief Engineer, Richards Engineering Corporation

Among the many inventions brought forth by the Great War is the development of airplane and airship hangars to a degree hitherto unforeseen.

The Richards Patent airplane hangar is such a product of the war and was originally designed to solve a very important problem with which the British government was faced

Fig 1. CORNER VIEW OF RICHARDS TYPE A AIRPLANE HANGAR WITH FRONT CURTAINS OPENED

early in the war, that of providing for airplanes a hangar which would fulfill the following requirements.

(1) A minimum span of 72 ft
(2) Weight not to exceed 11,500 lb
(3) Ease in erection—a vital consideration
(4) Ease of transport—equally important.

Having satisfied the government engineers that the design submitted was the probable solution to the problem, the first Richards Type "A" airplane hangar (see Figs. 1 and 2) was built and erected to the following dimensions. A clear floor space of 72 ft. wide by 40 ft. deep and front opening 72 ft. wide by 14 ft. 4 in. clear height and droping in height at the back to 6 ft. 4 in. There is an additional floor space at the rear 72 ft. by 8 ft. available for use as a store or workshop.

This was thoroughly tested by the engineers attached to the American Expeditionary Forces and submitted to the following severe test.

Test.—For the purposes of loading for the test, sacks of cement totalling 1925 lb. were suspended from each of the two centre trusses at the king post and also at the tip of each cantilever, making a total of 7700 lb. carried by the cantilevers of the two intermediate trusses.

Deflection.—The maximum deflection under this loading and registered at the tip of the cantilever was only ¾ in.

The chief advantages of the Richards hangars are

(1) *Economy of material.* Less material is used in this size hangar than in any other type of similar dimensions.
(2) *Lightness of structure.* Having regard to the advantage above it is obvious that the resultant structure effects a corresponding saving in weight and due in part to the special manner of forming the hollow box sections it is still maintaining the necessary strength.
(3) *Interlocking Fittings.* The members of the structure

Fig 2. FRAMEWORK OF A RICHARDS TYPE B AIRPLANE HANGAR ERECTED AT THE CANADIAN NATIONAL EXHIBITION IN TORONTO

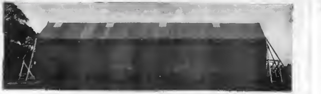

Fig. 1 FRONT VIEW OF RICHARDS TYPE B AIRPLANE HANGAR WITH FRONT CURTAINS CLOSED

are so designed that the end of each member is fitted with specially designed connections so that the adjoining member interlocks.

(4) *Erection* This is handled by twelve men and erected in one day, six men complete the structure by covering it with waterproof canvas The canvas door curtains are divided at the centre, half sliding to each side allows the machine to pass in or out of the hangar Practically no skilled labor is required This is a great advantage especially where skilled labor is not available, and such circumstances are likely to arise having regard to the future commercial possibilities of aircraft in isolated parts of the world.

(5) *Transport.* The structure is designed in such a way that no single part exceeds 15 ft in length, and each member can be lifted by one man This hangar can be packed and carried by one large Army truck.

(6) *Foundations* A point of great interest is that special foundations are not necessary, this is cared for in the structure by large steel ground bearing plates. For securing these hangars to the ground against the action of the wind, specially designed anchors are screwed into the ground and attached to the base plates. The depth these penetrate the earth varies according to the stresses at that part They are from 3 ft to 6 ft in length In practise they have proved very efficient fastenings. These hangars have been erected on all kinds of soil from the hard stone kind down to made-up ground. Those readers who visited the recent Toronto Exhibition saw an example of these hangars erected on the reclaimed lake shore, and in spite of the very heavy downpour of rain and severe winds they were as sound at the close of the Exhibition as the day they were erected.

As the war proceeded and military airplanes grew ever larger in size, the same problem that faced the authorities earlier in the war had once again to be met for housing these machines with their great overall wing spread. It was then that the Richards Type B hangar (see Fig 3) was built and erected, more especially for sheltering the large Handley Page bombing machines.

The Richard Type B hangar has a clear floor space of 130 ft. by 60 ft. and a front opening of 130 ft wide by 25 ft. clear height, and dropping to 20 ft in height at the back At the rear, and extending the whole length, is an additional floor space of 130 ft. by 20 ft for use as a store or workshop The authorities spared no pains to ascertain if this hangar was the one they were seeking and if it satisfied all their needs. Hence it was officially tested.

Test—The British government engineers applied a similar test to this hangar as was done in the case of the Type A. This was obtained by suspending weighed material from each of the three intermediate cantilever trusses, 2058 lb. from each king post end also at the tip of each cantilever and 4116 lb from the joint midway between the king post and the toe, making a total of 18,522 lb.

Deflection.—The maximum deflection from this loading registered at the toe of the centre truss was only 1½ in and under the toe of each the other trusses was 1⅜ in. This undoubtedly is a highly satisfactory result for a portable structure of this type and dimensions.

Construction—The same portability has been maintained in this hangar as in the smaller type of having interlocking fittings and large base plates. The maximum length of any one member is 16 ft. The whole of this enormous structure can be stacked into six Army trucks

Erection—This giant hangar is erected by sixteen to twenty men in about five days, eight to ten men complete the covering of the waterproofed canvas in two days

Over 650 hangars of the Type "A" size were constructed for use during the war and about 120 of the Type "B" size.

In the recent cross Atlantic flight out of the four hangars taken to Newfoundland three were Richards Patent airplane hangars, which demonstrated the popularity this hangar enjoys in the world of British aeronautics.

The Richards Engineering Corp. have designed these hangars with a view to be suitable for a more permanent covering, such as corrugated steel or corrugated asbestos sheets, boarding and felt, etc., with either a wood or steel framing. They have also had extensive experience in the design of airship sheds, permanent aerodrome structures and air stations.

Petroleum and Allied Substances

In order that the oil men of the country may keep in closer touch with the recent publications on petroleum, the Petroleum Division of the Bureau of Mines, Department of the Interior, proposes to issue monthly a bibliography of petroleum prepared by E H Burroughs Copies will be sent each month to the various oil trade journals for publication and to certain libraries which receive inquiries regarding petroleum. In addition, copies will be sent to bonafide petroleum organizations such as the Western Refiners' Petroleum Association, American Petroleum Institute, etc. It is not the purpose of the Bureau of Mines to establish an individual mailing list, the bureau rather trusting that the various oil trade journals will supply this information from the copies they will be supplied with by the bureau. These bibliographies will be sent to the oil press for publication as near the first of each month as practicable

The bureau, since 1915, has published annually a bibliography of petroleum, which is very inclusive and pertains to various phases of the petroleum industry The report containing references to articles and books published during 1917 is now in the hands of the editor and should appear before the end of this year The 1918 bibliography should be issued within the next several months, and it is hoped that the 1919 report will be issued within eight months after the close of the year It is in order to avoid these delays, which detract from the value of bibliographies, that the Bureau of Mines proposes to issue monthly bibliographies.

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Statement of the ownership, management, circulation, etc., required by the act of Congress of August 24, 1912, of AVIATION AND AERONAUTICAL ENGINEERING, published semi-monthly at New York, N. Y., for October 1, 1919

STATE OF NEW YORK } ss.
COUNTY OF NEW YORK }

Before me, a Notary Public in and for the State and county aforesaid personally appeared Herbert M. Williams, who having been duly sworn according to law, deposes and says that he is the business manager of AVIATION AND AERONAUTICAL ENGINEERING, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, The Gardner-Moffat Company, Inc., 22 East 17th St., New York.

Editor, Lester D. Gardner, 22 East 17th St., New York.

Managing Editor, None.

Business Managers, Herbert M. Williams, George Newbold, 22 East 17th St., New York.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent. or more of the total amount of stock.) The Gardner-Moffat Company, Inc., 22 East 17th St., New York; Lester D. Gardner, 22 East 17th St., New York; W. I. Seaman, 22 East 17th St., New York; W. D. Moffat, 22 East 17th St., New York; Margaret K. Gardner, 22 East 17th St., New York.

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4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

HERBERT M. WILLIAMS,
Business Manager

Sworn to and subscribed before me this 6th day of October, 1919.

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